CLAIMS:

We claim:

Sub a1

1. A system for preventing ice formation on a surface of a solid object, comprising:

a first electrode disposed on the surface;

a second electrode proximate to the first electrode;

an interelectrode space separating the first and second electrodes; and

an AC power source connected to the first and second electrodes, the power source capable of providing an AC voltage with sufficient power to prevent freezing of a liquid water layer in the interelectrode space.

2. A system as in claim 1,wherein the power source is capable of providing an AC voltage having a frequency in a range of from 15 Hz to 1 kHz.

3. A system as in claim 1,wherein the power source is capable of providing an AC voltage having a frequency in a range greater than 1 kHz.

4. A system as in claim 1, wherein the power source is capable of providing an AC voltage in a range of from 0.1 to 100 volts.

5. A system as in claim 4, wherein the power source is capable of providing an AC voltage in a range of from 5 to 25 volts.

6. A system as in claim 1, wherein the power source is capable of providing a current density in a liquid water layer in the interelectrode space in a range of from 1 to 100 mA/cm^2.

7. A system as in claim 1, wherein the power source is capable of providing a current density greater than 10 mA/cm^2.

8. A system as in claim 1, wherein the interelectrode space has a thickness not exceeding 3 mm.

9. A system as in claim 1, wherein the interelectrode space has a thickness not exceeding 500 μm.

10. A system as in claim 1, wherein the interelectrode space has a thickness in a range of from 5 nm to 100 μm.

11. A system as in claim 1, wherein the first electrode comprises a material selected from the group consisting of aluminum, copper, titanium, platinum, nickel, gold, mercury, palladium, carbon, SnO_2, $InSnO_2$, RuO_2 and IrO_2.

12. A system as in claim 1, wherein the second electrode comprises a material selected from the group consisting of aluminum, copper, titanium, platinum, nickel, gold, mercury, palladium, carbon, SnO_2, $InSnO_2$, RuO_2 and IrO_2.

13. A system as in claim 1, wherein the surface is electrically nonconductive, the first electrode is disposed on a first portion of the surface, a second electrode is disposed on a second portion of the surface, and a third portion of the surface is located between the first and second electrodes. of the object.

14. A system as in claim 13, wherein the first electrode and the second electrode are interdigitated.

15. A system as in claim 1, wherein the second electrode covers the first electrode, and the second electrode is exposed to water and is porous to water.

16. A system as in claim 15, wherein the second electrode is a mesh comprising metal mesh fibers.

17. A system as in claim 16, wherein the metal mesh fibers have a thickness in a range of from 1 to 100 μm.

18. A system as in claim 15, further comprising a porous insulator layer disposed between the first electrode and the second electrode, the porous insulator layer forming the interelectrode space and being porous to water.

19. A system as in claim 18, wherein the porous insulator layer has a total volume and a pore space, and the pore space occupies between 0 and 100 percent of the total volume.

20. A system as in claim 19, wherein the pore space occupies in a range of from 50 to 70 percent of the total volume.

21. A system as in claim 18, wherein the first electrode comprises aluminum and the porous insulator layer comprises aluminum oxide.

22. A system as in claim 21, wherein the porous insulator layer comprises anodized aluminum.

23. A system as in claim 1, wherein the surface of the solid object includes the first electrode.

24. A system for preventing ice formation on a surface of a solid object, comprising:

a first electrode disposed on the surface;

a second electrode proximate to the first electrode;

an interelectrode space separating the first and second electrodes; and

a DC power source connected to the first and second electrodes, the power source capable of providing a DC voltage with sufficient power to prevent freezing of a liquid water layer in the interelectrode space.

25. A system as in claim 24, wherein the power source is capable of providing a DC voltage in a range of from 0.1 to 100 volts.

26. A system as in claim 24, wherein the power source is capable of providing a current density in a liquid water layer in the interelectrode space in a range of from 1 to 100 mA/cm^2.

27. A system as in claim 24, wherein the interelectrode space has a thickness not exceeding 3 mm.

28. A method for preventing ice formation in a liquid water layer, comprising:

flowing an electric current through the liquid water layer.

29. A method as in claim 28, wherein the electrical current has a current density in a range of from 1 to 100 mA/cm^2.

30. A method as in claim 28, wherein the power source is capable of providing a current density greater than 10 mA/cm^2.

31. A method as in claim 28, wherein the electrical current comprises AC current.

32. A method as in claim 31, wherein the AC current has a frequency greater than 15 Hz.

33. A method as in claim 28, wherein flowing an electric current through the liquid water layer comprises steps of:

providing an electrode having an interface with the liquid water layer; and

providing a voltage at the electrode.

34. A method as in claim 33, wherein the voltage has a magnitude in the range of from 0.1 to 100 volts.

35. A method as in claim 33, wherein the voltage comprises an AC voltage.

36. A method as in claim 35, wherein the AC voltage has a frequency in a range of from 15 Hz to 1 kHz.

37. A method as in claim 28, wherein flowing an electric current through the liquid water layer comprises steps of:

providing a first electrode on a surface;

providing a second electrode proximate to the first electrode, thereby forming an interelectrode space between the first electrode and the second electrode, wherein the liquid water layer is disposed in the interelectrode space; and

applying electric power between the first and second electrodes, the power being sufficient to prevent freezing of the liquid water layer in the interelectrode space.

38. A method as in claim 37, wherein the electric power is AC power and the step of applying electric power comprises providing an AC voltage.

39. A method as in claim 38, wherein the AC voltage has a frequency in a range of from 15 Hz to 1 kHz.

40. A method as in claim 38, wherein the AC voltage has a value in a range of from 0.1 to 100 volts.

41. A method as in claim 40, wherein the AC voltage has a value in a range of from 5 to 25 volts.

42. A method as in claim 37, wherein the step of applying electric power causes a current density in a liquid water layer in the interelectrode space in a range of from 10 to 100 mA/cm^2.

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